

EMPLOYEE EXPOSURE TO PESTICIDE RESIDUE AND NUISANCE DUST
DURING THE MECHANICAL SHAKING AND SWEEPING OF ALMOND
HARVEST DURING AUGUST AND SEPTEMBER 1984

by

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HS-1283 January 11, 1985

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SUMMARY

Operations of mechanical shakers and sweepers were monitored for airborne pesticide residue and nuisance dust during almond harvest in the fall of 1984. Studies were conducted in Fresno, Merced, Stanislaus, and San Joaquin Counties. Thirty-one air samples were collected from the environment of harvest workers. Only one sample contained a detectable level of pesticide residue. The average of nuisance dust concentrations was 334 milligrams per cubic meter for sweepers, 105 milligrams per cubic meter for shakers, and 107 milligrams per cubic meter for two pickup machines. For the conditions and locations studies, worker inhalation of hazardous levels of pesticides did not appear to be occurring.

INTRODUCTION

A unique localized environment is created during the activities of almond harvesting. Almonds are harvested by mechanically shaking the tree trunk and/or larger branches for about five seconds. In that time, the almonds are released from the tree along with much of the dust which has accumulated over the growing season. The nuts are allowed to dry on the ground for approximately one week, then they are swept into windrows to be picked up. The sweeping operation may create enough airborne dust from the orchard floor to obscure the machinery in a cloud of dust. The purpose of this study was to see if a significant hazard existed for almond harvest workers from airborne pesticides. The nuisance dust concentration, which is a combination of respirable and nonrespirable dust, was determined in the workers' environment.

METHODS AND MATERIALS

Samples were collected in the San Joaquin Valley during August and September 1984. The county agricultural commissioners' offices supplied names of almond growers. These growers were contacted and arrangements were made to monitor shakers and sweepers in their orchards.

A mechanical shaker is a tractor-type vehicle with a long boom mounted in front. The boom has jaws which can be directed to grab the tree and shake it for a few seconds. The operator is positioned approximately 10 to 12 feet from the tree trunk. One shaker had a closed, air-conditioned cab; the others were open-cab vehicles with a roof to protect the driver from falling nuts and debris.

The sweeper has belts and brushes that sweep the nuts in one direction and a blower that blows in the opposite direction. A pickup machine has belts under the center of the machine that picks the nuts off the ground and deposits them in a hopper.

The environment of the machine operator was monitored for airborne dust. Samples were collected in three-piece 37 mm cartridges with an 0.8 micron glass fiber filter. The cartridges were assembled, dessicated, and weighed prior to use. MSA Fixt-Flow air pumps, set at 1.0 liter per minute, were used for sampling. A Tygon hose attached the cartridge to the pump. The cartridge was taped to the machinery (gear shift lever or elsewhere) so that it was one to three feet from the operator's breathing zone. This method of attachment caused the least inconvenience for the worker. Initial flow rates were calibrated using a Kurz 540 S flow calibrator. Sample times varied from one to five hours.

At the end of the sample period, the cartridge and pump were checked with the Kurz flow calibrator for final flow rates. The cartridges were then capped, wiped to remove external dust, stored on ice, and shipped to California Department of Food and Agriculture (CDFA) Chemistry Laboratory Services in Sacramento for next-day analysis.

Hand wash samples were taken to correspond with air sampling from eight workers. At the end of the sampling period, the workers were asked to rinse their hands in 400 ml of 0.05 percent Surten in water in a large polyethylene bag. The rinse solution was transferred to a glass jar, sealed with foil, and stored on ice. Samples were shipped to CDFA's Chemistry Laboratory Services in Sacramento for next-day analysis.

The air sampling cartridge was dessicated upon receipt at the laboratory, then weighted to determine the amount of dust collected.

The air filters and hand wash solutions were extracted with ethylacetate. The ethylacetate was passed through a bed of anhydrous sodium sulfate, rotary evaporated to volume, and analyzed by gas chromatography. Ambush and Omite were analyzed using an electron capture detector. The other pesticides were analyzed with a nitrogen phosphorous detector.

RESULTS

Specific pesticide analyses were made for each sample, dependent on the chemicals that had been applied to that orchard. Some spray histories included dormant sprays, others were limited to spring and summer applications. The various analyses conducted include: Guthion, Ambush, Omite, Diazinon, Supracide, Parathion, Imidan, and Zolone. Pesticide was detected in only one of the 31 samples, that being from a pickup machine, and consisted of 521 ppb Ambush. Table 1 shows results of pesticide analyses.

Airborne nuisance dust concentrations are represented in milligrams per cubic meter, calculated from sample weight and sample size in liters. Table 2 presents dust concentrations and sample parameters. The average dust₃ concentration for individual samples is 334 mg/m³ for sweepers, 105 mg/m³ for shakers, and 107 mg/m³ for the two pickup machines.

Hand wash samples were taken on only two of the sampling days. Results show a discrepancy as the same four workers were monitored in the same environment on succeeding days with different results. Positive results were obtained from workers monitored on one day, negative results on the other day. Table 3 shows hand wash results.

DISCUSSION

Results indicate that almond harvest worker exposure to airborne pesticide is minimal. The exposure situation to shakers is unique with foliar dust and possible pesticides being shaken onto a worker. One would not expect pesticides to be present at harvest, since the most recent application is generally one to two months earlier. This time span apparently allows adequate time for pesticides to degrade through normal environmental pathways.

Nuisance dust, by definition is a combination of respirable and nonrespirable dust. The California Occupational Safety and Health Administration's standard for nuisance dust in an industrial situation is 10 mg/m³ Time

Weighted Average (TWA), based on an eight-hour day. Generally, in this study, only one sample per day was taken from each worker to represent a portion of his typical workday. Since only one sample per worker per day was taken, the dust concentration found in that sample may be approximated to be an eight-hour time weighted average for that worker. Based on this approximation, only two of the thirty-one samples would meet an acceptable level for industrial nuisance dust concentration. Approximately half of the workers monitored wore paper-type dust masks over their mouth and nose.

Soil type, irrigation methods, and cultural practices all affect the amount of dust that is created in a given orchard. A sandy soil with drip irrigation will be much dustier than a clay soil that is flood or sprinkler irrigated. In some orchards, an annual forage crop is planted between the trees. The low ground cover is mowed and the orchard is never cultivated; this leads to a compacted, hard orchard floor. Table 4 compares the orchard environment with dust concentrations found in this study.

No conclusions can be drawn from the hand wash samples. Half of the hand washes were positive for Guthion; air samples corresponding to the same workers were negative. The negative hand washes were taken under identical conditions and with the same workers as the positive results. The discrepancy may be due to actual conditions, storage conditions, or laboratory conditions.

CONCLUSIONS

This study has shown that almond harvest worker exposure to airborne pesticides was minimal in these locations for the 1984 season. Dust concentrations, which were known to be high, have been quantitated. Further hand wash studies should be conducted to ascertain whether or not significant dermal pesticide exposure is occurring at harvest time.

TABLE 1

Results of Analysis of Samples for Airborne
Concentrations of Pesticide Residues in the
Breathing Zone of Almond Harvest Workers

<u>Sample Source</u>	<u>Weight Sample (mg)</u>	<u>Pesticide</u>	<u>Results of Pesticide Analysis (ppm)</u>
Sweeper	24	Guthion	<2.776
Sweeper	185	Guthion	<4.000
Pickup	15	Ambush	520.7
Pickup	44	Ambush	<.585
Shaker	80	Ambush	<.793
Sweeper	194	Ambush	<.888
Shaker	9	Guthion	<2.105
Shaker	79	Guthion	<2.105
Shaker	10	Ambush	<.980
Sweeper	33	Ambush	<.998
Shaker	18	Omite	<.394
		Guthion	<4.033
Sweeper	8	Guthion	<5.346
Shaker	2	Guthion	<3.901
Shaker	2	Guthion	<2.577
Sweeper	2	Guthion	<3.097
Shaker	13	Guthion	<4.570
Sweeper	158	Guthion	<2.887
Sweeper	130	Omite	<.335
		Guthion	<3.480
Sweeper	104	Omite	<.480
		Guthion	<4.915
		Diazinon	<.190
Sweeper	14	Omite	<.558
		Guthion	<5.713
		Diazinon	<.223
Sweeper	85	Omite	<.391
		Guthion	<4.009
		Diazinon	<.160
Sweeper	24	Guthion	<49.515
Shaker	3	Omite	<.248
		Guthion	<2.539
		Diazinon	<.100
Shaker	20	Omite	<.352
		Guthion	<3.608
		Diazinon	<.140
Shaker	14	Omite	<1.239
		Guthion	<6.348
		Diazinon	<.250
Sweeper	11	Guthion	<3.007
		Supracide	<.118
Shaker	15	Guthion	<2.673
		Supracide	<.095

TABLE 1 (CONTINUED)

<u>Sample Source</u>	<u>Weight Sample (mg)</u>	<u>Pesticide</u>	<u>Results of Pesticide Analysis (ppm)</u>
Shaker	1	Guthion	<3.462
		Supracide	<.136
Sweeper	7	Papathion	<.078
		Imidan	<.571
		Zolone	<3.570
Sweeper	5	Guthion	<2.830
Sweeper	50	Omite	<.343
		Guthion	<3.516

TABLE 2
NUISANCE DUST CONCENTRATION FOUND
IN THE BREATHING ZONE OF
ALMOND HARVEST WORKERS

Sample Source	Sample Time (Min.)	Weight Sample (mg)	Sample Size (L)	Dust Concentration (mg/m3)
Shaker	210	80	200	401.00
Shaker	240	9	221	40.76
Shaker	240	79	228	346.49
Shaker	170	10	162	61.92
Shaker	170	18	165	109.16
Shaker	185	2	170	11.75
Shaker	280	2	258	7.76
Shaker	150	13	142	91.23
Shaker	300	3	285	10.53
Shaker	190	20	190	105.26
Shaker	120	14	114	122.81
Shaker	285	15	271	55.40
Shaker	220	1	198	5.05
Sweeper	260	24	239	100.23
Sweeper	195	85	185	459.00
Sweeper	192	194	182	1,063.60
Sweeper	167	33	167	197.60
Sweeper	135	8	131	61.09
Sweeper	70	2	64	31.06
Sweeper	250	158	230	686.96
Sweeper	200	130	194	670.10
Sweeper	155	104	147	706.28
Sweeper	120	14	120	116.67
Sweeper	190	85	171	497.08
Sweeper	75	24	64	376.47
Sweeper	240	11	221	49.82
Sweeper	120	7	120	58.33
Sweeper	255	5	247	20.21
Sweeper	195	50	195	256.41
Pickup	258	15	250	59.94
Pickup	285	44	295	154.39

TABLE 3
RESULTS OF HAND WASH SAMPLING
OF ALMOND HARVEST WORKERS

<u>Sample Source</u>	<u>Date</u>	<u>Pesticide Analysis (ppm)</u>			
		<u>Guthion</u>	<u>Op (Dursban)</u>	<u>Diazinon</u>	<u>Omite</u>
Sweeper	9-11	0.900		0.073	ND <.021
Sweeper	9-11	0.256		0.032	ND <.021
Sweeper	9-11	0.002		ND <.004	ND <.021
Sweeper	9-11	0.003		ND <.004	ND <.021
Sweeper	9-12	ND <0.1	ND <.03		ND <0.01
Sweeper	9-12	ND <0.1	ND <.03		ND <0.01
Sweeper	9-12	ND <0.1	ND <.03		ND <0.01
Sweeper	9-12	ND <0.1	ND <.03		ND <0.01

ND = None Detected

TABLE 4
DUST CONCENTRATION FOUND AS RELATED TO
ORCHARD ENVIRONMENT

<u>Sample Source</u>	<u>Dust Concentration (mg/m3)</u>	<u>Orchard Environment</u>
<u>Fresno County</u>		
Pickup Machine	60	Drip irrigation; very sandy soil.
Pickup Machine	154	
Shaker	401	No till, clover in some rows; slight crust on soil; sprinkler irrigated.
Shaker	62	
Sweeper	1,064	
Sweeper	198	
Shaker	41	
Shaker	347	
Shaker	8	
Shaker	91	
Sweeper	100	
Sweeper	459	
Sweeper	31	Heavy grass clippings in row sprinkler irrigated.
Sweeper	687	
Sweeper	376	
Sweeper	20	
Shaker	109	
Shaker	11	
Shaker	105	
Shaker	123	
Sweeper	256	
Sweeper	497	
Sweeper	117	
Sweeper	706	
Sweeper	670	
<u>Merced County</u>		
Shaker	12	No till orchard; compacted, sandy soil.
Sweeper	61	
<u>Stanislaus County</u>		
Sweeper	58	Floated, sprinkler irrigated; hard crust.
<u>San Joaquin County</u>		
Shaker	55	Sprinkler irrigated; slight crust on soil.
Shaker	5	
Sweeper	50	